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LUMINARY Memo #81

To: Distribution
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Subject: Landing Dependence on Platform Alignment

The landing, unlike other powered flight programs, depends on a particular platform alignment, the "lunar landing alignment" described in the GSOP section 5.1.4.2, also section 5.3.4.2.3 and in chapter 4 assumption 3 of programs 63 - 67. The landing site alignment is the local vertical at the site at TLAND with the z-axis in the CSM orbital plane.

Questions have arisen of how sensitive the landing is to wrong alignments - that is alignments different from the lunar landing alignment, but accurately reflected in REFSMMAT. Slipping the landing one orbit without realigning the platform is one case in which wrongness develops - about one degree. Redesignations by shifting the site introduce wrongness, but of negligible magnitude.

The permissable wrongness was first cautiously estimated as one degree. It was hypothesized that five degrees in any direction is okay, and runs were made which confirm this. Five degrees can be noticed, but can easily be tolerated.

There follows some background and a description of the runs.

The lunar landing alignment is assumed in three places in the landing programs:

(1) in the radial control logic where the x and y axes of the platform define the directions, by assumption radial and out-of-plane, which are favored in the allotment of available thrust.

(2) in the redesignation logic where certain very wrong alignments could cause the site to be involuntarily redesignated, or cause the new site in the event of a voluntary redesignation to be wrong.

(3) in the ignition algorithm where the guidance-to-platform transformation matrix is initialized as the identity matrix: in this case the matrix would soon be corrected, but meanwhile the time-to-go computation may have blown up.

The runs were four: two in which the platform is wrong by a rotation of 5 degrees each way about its y-axis, arbitrarily called Y+5 for the case where the x-axis pierces the moon to the east of the site, and Y-5 for the occidental case; one run each with 5 degree x-axis and z-axis rotations, on the assumption that these cases are symmetrical.

The y runs were perceptibly different from the nominal in ignition time, throttle-down time, landing time, and achievement of high gate.

	ignition time (TIG-0)	throttle-down time	touch-down time	altitude and altitude rate from first P64 display (nominal: 7783 feet, -143.4 f/s)
Y-5	early .01 second	late about 7 seconds	early about 4 seconds	7594 feet -130.0 f/s
Y+5	late .01 second	early about 5 seconds	late about 2 seconds	7730 feet -154.3 f/s

There is nothing to worry one here.

The x run was very close to the nominal, differing slightly in throttle-down time.

The z run was indistinguishable from the nominal, except for noise. This is as expected since only a z-axis rotation does not affect radial control (because both the x and y axes are given thrust priority). The closeness of this run indicates that to radial control alone should be attributed the differences seen in the x and y cases.